13 21. The head suspension assembly of claim 1 including first, second, third and forth strain transducer circuits wherein the spring region has an open region that divides the spring region into first and second radius arms and the first and second strain transducer circuits are located on the first radius arm, the third and forth strain transducer circuits are located on the second radius arm, and the first, second, third and forth strain transducer circuits are interconnected to form a wheatstone bridge circuit.

Remarks

This Amendment is responsive to the Office Action mailed March 26, 1998. Claims 1-20 are pending in the application. In the Office Action, claims 1-20 were rejected under 35 U.S.C. § 112, second paragraph. Additionally, claims 1, 5-6, 10, 13 and 15-20 were rejected under 35 U.S.C. § 102(a) as anticipated by U.S. Patent No. 5,142,424, issued August 25, 1992 to Y. Hatamura ("Hatamura"). Also, claims 2-4, 7-9, 11-12 and 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hatamura in view of either U.S. Patent No. 5,014,145, issued May 7, 1991 to Hosokawa et al. ("Hosokawa et al.") or U.S. Patent No. 5,335, 126 issued August 2, 1994 to Tokyuama et al. ("Tokyuama et al."). With this Amendment, Applicant has amended claims 1-5, 7-9, 13, 15 and 17-20 and added new claim 21. Applicant believes that the application is now in condition for allowance.

Applicant has requested amendments to the specification and drawings. These amendments are requested only to correct typographical errors and other minor errors in drawing reference numbers. Also, at the request of the Examiner, Applicant has amended page 2 of the specification to update the status of U.S. Patent Application Serial No. 08/457,432. None of the requested amendments constitute new matter. Accordingly, Applicant respectfully requests entry of the amendments to the specification and drawings.

Claims 1-20 Are Not Indefinite Under 35 U.S.C. § 112

In the Office Action, claims 1-20 were rejected under Section 112, second paragraph, as being indefinite. In claim 1, the Examiner found that the phrase "and to detect strain in the head suspension assembly" had no structural basis. Applicant has amended claim 1 to

recite "at least one strain transducer circuit on the head suspension assembly for detecting strain therein." Because, by the express wording of the claim, the strain transducer circuit is located on the head suspension assembly, the phrase "for detecting strain therein" is believed to have structural basis.

In claims 2-4 and 7-9, the Examiner determined that it was not clear whether the phrase "at least one strain transducer circuit" referred back to the strain transducer circuit in claim 1. Claims 2-4 and 7-9 have each been amended to recite "the strain transducer circuit." Applicant believes that claims 2-4 and 7-9 are no longer ambiguous.

The Examiner found that in claims 3 and 8, the phrase "and the base" lacks an adequate basis. Applicant has amended claims 3 and 8 to replace "base" in the noted phrase with "mounting region," which appears in claim 1. Accordingly, Applicant believes that this element of claims 3 and 8 now has adequate basis. The Examiner also found that in claim 5, the phrase "the read/write head" had no positive support. Applicant has amended claim 5 to read "a head attachment region for supporting a read/write head." As such, Applicant believes that the element of "a read/write head" no longer lacks support.

The Examiner has also requested clarification in claim 5 of why an elastic deformation of the head suspension assembly will generate a strain that necessarily displaces the head attachment region from a neutral position. Applicant has amended claim 5 to recite: "wherein an elastic deformation of the head suspension assembly can displace the head attachment region from a neutral position and generate strain in the head suspension assembly." Applicant believes that claim 5 now makes clear that an elastic deformation can both displace the head attachment region and generate strain in the head suspension assembly.

The Examiner found that claims 13, 14 and 16 appeared to duplicates claims 5, 6 and 10, respectively. Applicant has amended claim 13 to recite a microactuator, which is not included in any of claims 5, 6 and 10. Claims 14 and 16 are dependent upon claim 13.

Accordingly, Applicant believes that claims 13, 14 and 16 are not duplicates of claim 5, 6 and 10, respectively.

In claim 17, the Examiner requested that the relationship between the actuator arm and the load beam be clarified with regard to the proximal and distal end of the load beam. Applicant has amended claim 17 so that the actuator arm has a proximal end and a distal end and the proximal end of the load beam is mounted to the distal end of the actuator arm. As such, Applicant believes that the relationship between the actuator arm and the load beam, including the reference to first and second strain transducer circuits in claims 19 and 20, is now clear.

For the above reasons, Applicant now believes that claims 1-20 particularly point out and distinctly claim the invention and are no longer indefinite. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 1-20 under Section 112.

Claims 1, 5, 6, 10, 13, and 15-20 Are Not Anticipated by Hatamura

The Examiner also rejected claims 1, 5, 6, 10, 13 and 15-20 under Section 102(a) as anticipated by Hatamura. Hatamura discloses a suspension for supporting an information-reading head to read information from a spinning magnetic disk. The suspension of Hatamura is designed to monitor and accommodate contact between the information-reading head and the spinning magnetic disk. The suspension includes a rectangular box-shaped load arm for supporting the information-reading head via a gimbal. The gimbal comprises a frame structure having a reverse trapezoidal shape. A head arm supports the load arm and is attached to a carriage for moving the suspension over the disk. Figures 6 and 7 of Hatamura each disclose a strain gauge on the head arm. The strain gauge is for detecting deformation of the surface of the head arm on which the strain gauge is mounted. A deformation of this surface is caused by frictional contact between the information-reading head and the spinning disk. A pin can move to raise the information-reading head away from the spinning disk if the frictional contact therebetween is too great.

As discussed in the specification, the head suspension assembly of the present invention includes a load beam having a spring region. The resilience of the spring region allows the read/write head to fly over the spinning disk on an air bearing while also providing a force towards the disk to balance a force away from the disk provided by the air bearing. In this way, the read/write head flies over the spinning disk at a specific "fly height" without contacting the disk. In such a system, the head suspension assembly exhibits various torsional and sway mode motions when driven at certain resonance frequencies. One object of the present invention is to detect this resonance mode motion. The present invention is not for detection of contact between an information-reading head and a spinning magnetic disk.

As such, Applicant respectfully asserts that the present invention includes elements not disclosed by Hatamura, and, therefore, that claims 1, 5, 6, 10, 13, and 15-20 are not anticipated by Hatamura. With this Amendment, Applicant has amended independent claims 1, 13 and 17. Additionally, Applicant has amended dependent claims 2-5, 7-9, 15 and 18-20 to conform these claims to the amended independent claims. As amended, claim 1 recites a head suspension assembly in which resonance mode motion can induce strain. The head suspension assembly includes a load beam and a flexure for supporting a read/write head. The load beam includes a proximal end, a distal end, a mounting region at the proximal end, a rigid region adjacent to the distal end and a spring region between the rigid region and the mounting region. At least one strain transducer circuit is on the head suspension assembly. The strain transducer circuit is for detection of strain in the head suspension assembly and thereby allows detection of resonance mode motion in the load beam.

Amended claim 1 includes elements not taught by Hatamura. First, Hatamura does not disclose that the either of the load arms shown in Figures 6 and 7, which include a strain gauge on the head arm, have a spring region. Amended claim 1, however, specifically recites a spring region in the load beam between the mounting region and the rigid region.

Additionally, claim 1 specifically recites that the strain transducer is for detection of resonance mode motion in the head suspension assembly. No place does Hatamura disclose that the strain gauge located on the head arm serves this purpose. Rather, as noted above, the strain gauge in Hatamura is for detecting contact between the information-reading head and the spinning disk--this has nothing to do with detection of resonance mode motion.

Also, claims 5, 6 and 10, which are dependent upon claim 1, include other elements which are neither disclosed nor taught by Hatamura. For these reasons, Applicant respectfully asserts that claims 1, 5, 6, and 10 are not anticipated by Hatamura and respectfully requests withdrawal of this grounds of rejection and allowance of these claims.

With respect to claims 13, 15 and 16, which the Examiner also rejected as anticipated by Hatamura, Applicant has amended independent claim 13 to recite a head suspension assembly having a load beam with a proximal end, a distal end, a mounting region on the proximal end, a rigid region adjacent to the distal end, and a spring region between the mounting region and the rigid region. The head suspension assembly also includes a flexure attached to the load beam. The flexure has a head attachment region displaceable from a neutral position, such displacement causing strain in the head suspension assembly. A microactuator is on the head suspension assembly between the mounting region and the head attachment region for displacing the head attachment region from the neutral position along a transverse tracking axis. At least one strain transducer circuit is on the head suspension assembly. The strain transducer circuit detects strain in the head suspension assembly such that displacement of the head attachment region from the neutral position caused by the microactuator is detected by the strain transducer circuit.

As amended, claim 13 includes elements not disclosed by Hatamura. First, claim 13 includes a microactuator on the head suspension assembly which displaces the head attachment region out of its neutral position and along a transverse axis. Though Hatamura discloses a pin which can move to raise the information-reading head away from the spinning disk, Hatamura does not disclose any type of microactuator located on the head suspension

which displaces a head attachment region along a transverse tracking axis. Additionally, claim 13 specifically recites a load beam having a spring region between the rigid region and the mounting region. As discussed above with respect to claim 1, Hatamura does not disclose a suspension having both a strain gauge and a load beam with a spring region.

Further, in claim 13, the strain transducer circuit is for detecting displacement of the head attachment region from the neutral position caused by the microactuator. As noted above, the strain transducer of Hatamura is for detecting contact between the information-reading head and the spinning magnetic disk, not for detection of motion of the information-reading head caused by the movable pin.

Further, claims 15 and 16 also include elements not disclosed by Hatamura. For these reasons, claim 13, 15 and 16 cannot be anticipated by Hatamura and Applicant respectfully requests withdrawal of this ground of rejection of claims 13, 15 and 16 and allowance thereof.

With regard to claims 17-20, Applicant has amended independent claim 17 to recite a head suspension assembly in which resonance mode motion induce strain. The head suspension assembly includes load beam having a proximal end, a distal end, a mounting region on a proximal end, a rigid region adjacent to the distal end and a spring region between the mounting region and the rigid region. The head suspension assembly also includes an actuator arm to which the proximal end of the head suspension assembly is mounted. A flexure for supporting a read/write head is at the distal end of the load beam. At least one strain transducer circuit is on the head suspension assembly and is for detecting strain in the head suspension assembly. In this way, the strain transducer circuit detects resonance mode motion of the head suspension assembly.

As amended, claim 17 includes elements not disclosed by Hatamura. First, claim 17 includes a load beam with a spring region. A strain transducer circuit is on the head suspension assembly. Hatamura discloses a strain gauge on a rectangular box-shaped head

arm. The head arm is part of a suspension which includes no spring region. While Figure 10a of Hatamura may disclose a suspension which appears more similar to that of the present invention, there is no strain gauge located on the suspension of Figure 10a. Thus, as noted above, the suspension on which Hatamura discloses a strain gauge is of an entirely different design than the head suspension assembly of amended claim 17.

Moreover, amended claim 17 specifically recites a strain transducer circuit for detecting resonance mode motion of the head suspension assembly. As discussed above, the strain gauge of Hatamura is for detecting contact between the information-reading head and spinning disk. Nowhere does Hatamura mention detection of resonance mode motion.

Further, while claim 19, which is dependent upon claim 17, recites a strain transducer circuit on the actuator arm, the strain transducer is for detection of resonance mode motion. As discussed above, Hatamura does not disclose this element. Moreover, claims 18 and 20 include additional features not disclosed by Hatamura.

For these reasons, claims 17-20 cannot be anticipated by Hatamura and Applicant respectfully requests withdrawal of this grounds of rejection and allowance of claims 17-20.

Claims 2-4, 7-9, 11, 12 and 14 Are Not Rendered Obvious By Hatamura in View of Either Hosokawa et al. or Tokyuama et al.

The Examiner also rejected claims 2-4, 7-9, 11-12 and 14 under 35 U.S.C. 103(a) as being unpatentable over Hatamura in view of either Hosokawa et al. or Tokyuama et al. Hosokawa et al. discloses a head positioning system having an amplifier mounted on a servo head arm to amplify a servo signal. Tokyuama et al. discloses a magnetic disk device having a magnetic head and a magnetic head supporting mechanism. The magnetic head supporting mechanism includes a support on which an amplification circuit can be placed. The amplification circuit is for amplifying a signal from the magnetic head.

Applicant respectfully asserts that claims 2-4, 7-9, 11, 12 and 14 are patentable over the cited references. Claims 2-4, 7-9, 11 and 12 are all dependent upon claim 1 and each include elements not disclosed or suggested by any of the cited references or any hypothetical combination thereof and which provide advantages over the inventions of the cited references. As noted above, amended claim 1 specifically recites a load beam having a strain transducer circuit for detecting resonance mode motion of the load beam. While Tokyuama et al. discloses a "strain gauge method" for detecting parameters such as output of the magnetic head, dust density and lubricant thickness (see Tokyuama et al. col. 20, lines 60-68 and col. 21, lines 1-5), nowhere do any of the references disclose use of a strain gauge to detect resonance mode motion in a load beam.

Indeed, nowhere in any of the cited references is resonance mode motion mentioned or, as explained on page 6 lines 7-24 of the specification, that such motion generally causes deformation of a load beam and, therefore, stress in the load beam. Thus, the cited references do not even disclose the principle of operation of the inventions of claims 2-4, 7-9, 11 and 12. As such, none of the cited references can include any suggestion of using a strain transducer circuit to detect resonance mode motion in a head suspension assembly.

The Examiner asserts that Figure 33 of Tokyuama et al. and Figures 6 and 10 of Hosokawa et al. show a "transducer assembly" located on a load beam. However, in both Tokyuama et al. and Hosokawa et al., the "transducer assemblies" to which the Examiner refers are amplification circuits. (See Hosokawa et al. col. 3, lines 40-45 and 55-65; Tokyuama et al., col. 19, lines 18-21.)

Applicant respectfully asserts that these amplification circuits are entirely different from the strain transducer circuit of the claimed invention. The amplifier circuits of Tokyuama et al. and Hosokawa et al. do not measure strain in a head suspension. Indeed, while the amplifier circuits may receive signals from a magnetic head, nowhere is it disclosed that the amplifier circuits sense anything from, or otherwise interact in any way with, the surfaces on which they are mounted (except to be supported by the surfaces). For

these reasons, Applicant respectfully asserts that detection of resonance frequency vibrations in a load beam is neither taught nor suggested by any of the cited references.

Further, as shown in Figure 3 and discussed on page 7, lines 3-17 of the specification, detection of resonance mode motion of a load beam advantageously allows correction of such motion through a feedback loop to an actuator. None of the cited references disclose features which would provide this advantage. Accordingly, because amended claim 1 includes elements not taught or suggested by the cited references and which provide an advantage thereover, Applicant respectfully asserts that amended claim 1 is patentable over the cited references.

Additionally, claims 2-4, 7-9, 11 and 12 include features which are neither taught nor suggested by the cited references and which provide advantages thereover. For example, claim 3 and 8 both include locating a strain transducer circuit in the spring region of the load beam. Claim 4 includes locating a strain transducer in the rigid region of the load beam. Claim 9 recites placing two strain transducer circuits in the spring region of a load beam. Accordingly, Applicant respectfully asserts that claims 2-4, 7-9, 11 and 12 are all patentable over the cited references and respectfully requests withdrawal of the rejection of these claims.

The Examiner also rejected claim 14 as unpatentable over Hatamura in view of Tokyuama et al. and Hosokawa et al. Applicant respectfully asserts, however, that claim 14 includes features not taught or suggested by any of the cited references or any hypothetical combination thereof, and which provide advantages over the inventions thereof. Claim 14 is dependent upon claim 13. As discussed above, claim 13 discloses a head suspension having a microactuator which displaces a head attachment region along a transverse tracking axis. This displacement causes strain in the head suspension assembly and is, therefore, detected by the strain transducer circuit. Claim 14 recites placement of the strain transducer circuit on the load beam.

As discussed above, none of the cited references disclose a microactuation device for moving a head attachment region along a transverse axis. Thus, although Hatamura and Tokyuama et al. do disclose strain gauges, neither reference could suggest use of a strain gauge to detect displacement caused by a microactuator, as specifically recited by claim 13.

Further, as discussed on page 7, lines 12-19, detection of displacement of the head attachment region caused by the microactuator of claim 13 advantageously can be important for correct placement of the load beam over the spinning disk by a primary actuator. Accordingly, claim 14 includes features not taught or suggested by the cited references and which provide an advantage over the inventions thereof. Thus, Applicant respectfully asserts the claim 14 is patentable over the cited references.

With this Amendment, Applicant has added new claim 21. Claim 21 is dependent upon claim 1 and recites four strain transducer circuits interconnected to form a wheatstone bridge circuit. Applicant believes claim 21 is patentable over the cited prior art and respectfully requests allowance of claim 21.

CONCLUSION

In view of the above amendment and remarks, withdrawal of the rejection and allowance of the application is respectfully solicited.

Respectfully Submitted,

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